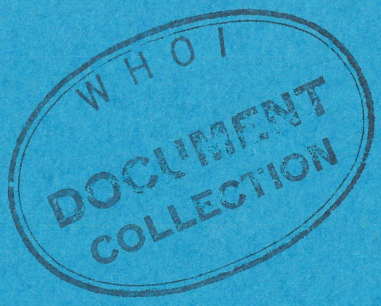
61-25
copy 2



WOODS HOLE OCEANOGRAPHIC INSTITUTION

Reference No. 61-25

SONAR RESEARCH conducted during the period
1 April - 30 June 1961

WOODS HOLE, MASSACHUSETTS

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts

Reference No. 61-25

SONAR RESEARCH conducted during the period 1 April - 30 June 1961

Quarterly Progress Report
Submitted to the Bureau of Ships
Under Contract NObsr-72521

August 1961

APPROVED FOR DISTRIBUTION Bostwick H. Ketchum

Bostwick H. Ketchum
Acting Director

TABLE OF CONTENTS

	Page No.
INTRODUCTION	1
REPORTS	2
TECHNICAL MEMORANDA	2
PAPERS	2
SOUND TRANSMISSION	3
Near Surface Sound Transmission	3
Instrumentation for Near-Surface Transmission Studies	4
ECHO, REVERBERATION, AND SCATTERING STUDIES	5
Short Range Scattering Studies at 12 kc	5
Cooperative Project with ComDesDevGroup II	5
SUBMARINE GEOLOGY AND GEOPHYSICS	5
Narragansett Bay Seismic Reflection Survey	5
Seismic Refraction Studies in the Mediterranean Sea	6
APPENDIX	6
Use of Vessels	6
Visitors's List	7
Personnel	9

INTRODUCTION

This is a progress report of the Institution's research between 1 April and 30 June 1961 supported under Contract NObsr-72521 with the Bureau of Ships, Navy Department. The program consists of studies of compressional wave transmission (sound and seismic waves) through sea water and the underlying earth's crust, the ambient noise of the ocean, and the scattering of sound in the sea and beneath the ocean floor.

During the present reporting period sound transmission studies have included laboratory analysis of data taken previously in a continuing program directed toward describing near-surface transmission into the shadow zone, and toward accounting for the variability of near-surface transmission under nominally "good" sonar conditions. Seismic studies consisted of analysis of seismic refraction data taken two years ago in the Mediterranean, completion of a report of a seismic reflection study of the southern part of Narragansett Bay, extension of this latter study into Rhode Island Sound, and a series of new measurements of the apparent reflectivity of the bottom at 12 kcps. In the sound-scattering program we accepted delivery of a small towed fish containing sound gear for scattering experiments over near-horizontal paths. This instrument was taken to sea on CHAIN for initial testing and self-noise measurements.

A series of tests of new sound sources, supported under Contract Nonr-1367, have demonstrated that seismic reflection observations can be made in deep ocean basins from a ship underway slowly using only such electrically-powered sources as Thumper or Sparker. Sub-bottom structures have been mapped in fine detail experimentally in water over 2600 fathoms deep. This work was done with a Thumper having a 5000-joule electrical input. Plans have been made for increasing the electrical input of Thumper to about 13,000 joules and Sparker to 25,000 joules. We plan to use these new sound sources in sound transmission experiments this summer and fall in the Mediterranean Sea.

As an extra-curricular hobby Miss Broughton, a technical assistant at the Institution, made interesting magnetic tape recordings of the sounds of a small pilot whale stranded on a local beach. She held microphones on the whale's head near the blow hole. The recorded sounds are rather different from those heard through the water near pilot whales.

These and other parts of our work are detailed below.

REPORTS

The following technical reports have been completed during this period:

WHOI Ref. No. 60-38. Instruction Manual for Precision Graphic Recorder (PGR) by S. T. Knott and W. E. Witzell dated October 1960. Prepared under Contracts Nonr-1367(00) and NObsr-72521. (Unclassified)

WHOI Ref. No. 61-19. Seismic Reflection Study of the Geologic Structure Underlying Southern Narragansett Bay, Rhode Island by J. B. Hersey, Anne H. Nalwalk, and D. R. Fink dated June 1961. Prepared under Contract NObsr-72521. (Unclassified) (Submitted to U. S. Army Corps. of Engineers 28 June 1961 in fulfillment of a contract to furnish ship time only. This report will be submitted to BuShips as soon as it can be reproduced.)

TECHNICAL MEMORANDA

WHOI Tech. Memo #1-61. Cruise Plan for CHAIN Cruise #19 June-July 1961. J. B. Hersey, editor. Prepared under Contract Nonr-1367(00). (Unclassified)

WHOI Tech. Memo #2-61. R/V ATLANTIS Cruise #266, Blake Plateau June-July 1961 by T. R. Stetson. Prepared under Contract NObsr-72521. (Unclassified)

WHOI Tech. Memo #3-61. Cruise Plan for R/V BEAR #264 Gulf of Maine Seismic Study 26 June - 20 July 1961 by J. W. Graham and D. A. Fahlquist. Prepared under Contract Nonr-1367(00). (Unclassified)

WHOI Tech. Memo #4-61. Cruise Plans for CHAIN Cruise #21 August - December 1961. Prepared under Contract Nonr-1367(00). (Unclassified)

PAPERS

The following papers were submitted for publication:

Contribution No. 1181. Sound Scattering Layers and their Relation to Thermal Structure in the Strait of Gibraltar by R. Frassetto, R. H. Backus, and E. E. Hays. Submitted to Deep-Sea Research. Prepared under Contract Nonr-1367(00) and NSF Grant 9579.

Contribution No. 1189. Evidence of an Eastward Equatorial Undercurrent in the Atlantic from Measurements of Current Shear by A. D. Voorhis. Submitted to Nature. Prepared under Contract Nonr-1367(00).

Contribution No. 1194. Some Heat Flow Measurements in the North Atlantic by John Reitzel. Submitted to Journal of Geophysical Research. Prepared under Contract Nonr-1367(00).

The following paper was published:

The Stranding of a Cuvier's Beaked Whale (Ziphius cavirostris) in Rhode Island, U. S. A. by R. H. Backus and W. E. Schevill. Norwegian Whaling Gazette, May 1961, No. 5, pp. 177-181.

SOUND TRANSMISSION

Near Surface Sound Transmission (Dr. Hays and Mr. Bergstrom).

The ten hydrophones mounted along the thermistor chain were used for receiving elements in our near surface sound transmission runs in Norwegian waters last fall. Sources used were explosives spaced at close intervals and the 1,000 joule Thumper. The transmission runs were recorded on magnetic tape. Analysis of these tapes was begun in June with the aid of summer employees. The records are played back through filters and into an Oceanographic computer which measures the quantity $\int p^2 dt$.

We also record the shape of the rectified envelopes of the arrivals as functions of range and frequency. An example of these arrivals is shown in Figure 1. Here the direct arrival (perhaps better the simple-ray-theory arrival) is seen to disappear, indicating a shadow zone, but substantial energy in the lower frequencies persists for considerably longer ranges.

From the energy vs range plots, the arrival times, the thermistor chain data on temperature structure, and appropriate transmission theory, we hope to achieve a better understanding of near surface transmission through the shadow zone. The large number of detectors and rapid source rates used, give us for the first time enough experimental information to really attack the problem.

Instrumentation for Near-Surface Transmission Studies (Mr. Caulfield and others).

Recent study has made it feasible for us to design a considerably more powerful Sparker (underwater spark discharge as a sound source) than we have previously operated. (The Sparker development is supported under Contract Nonr-1367(00) with the Office of Naval Research.) The basic research has been completed and the final engineering and construction details are being worked out for a 25,000 joule spark source. This device will be capable of firing once every 2.5 seconds at full power. It is planned to have this unit aboard CHAIN for sound transmission studies in the Mediterranean this fall.

We are working the hydrophone-preamplifier assemblies that have been mounted in the thermistor chain so that calibration signals may be used through the system. In the first model it was necessary to use an external hydrophone and amplifier as a reference system in order to calibrate the thermistor chain system. Some improvements are also being made to the overload monitoring equipment.

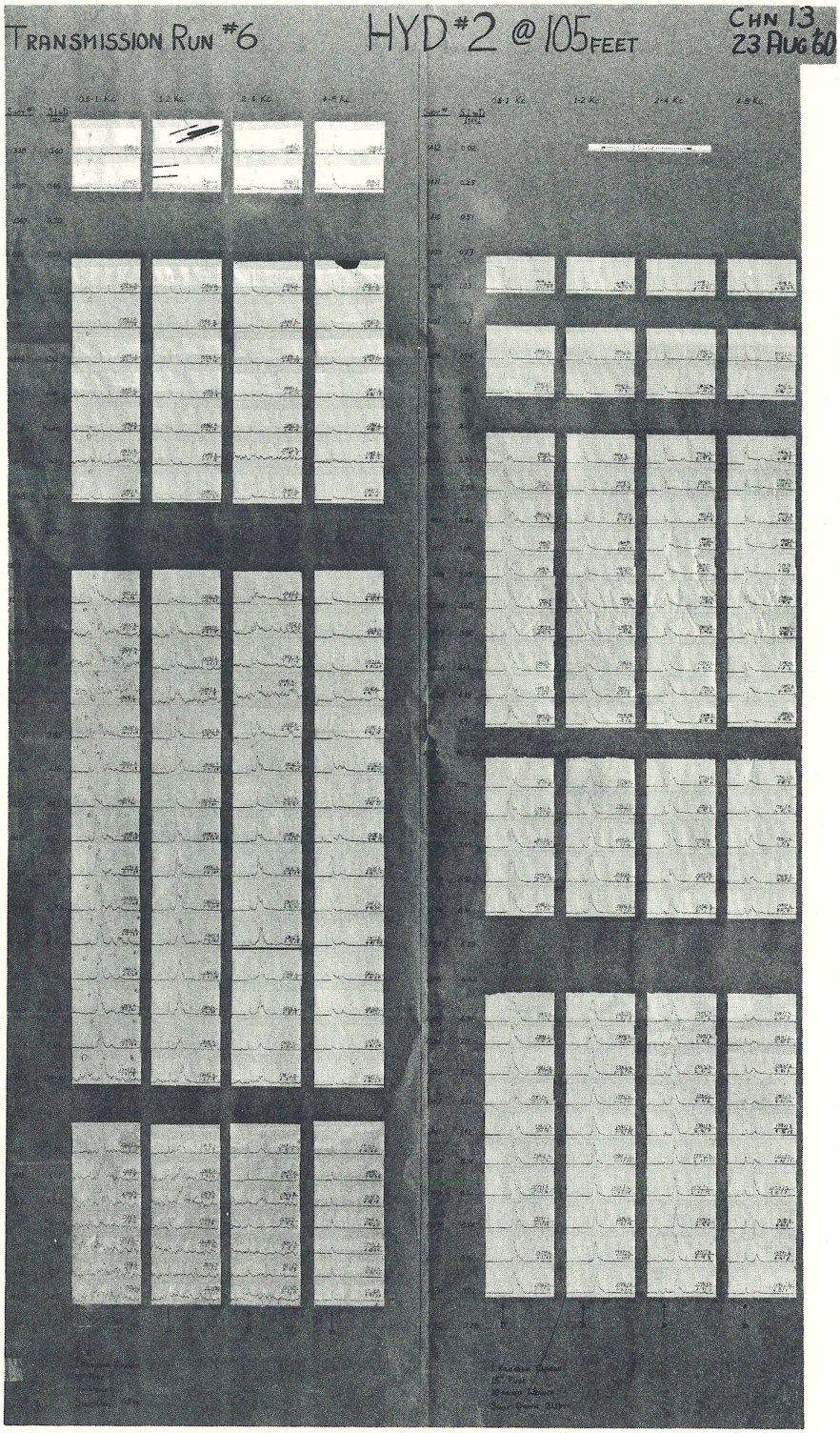


FIGURE 1. RECTIFIED ENVELOPES OF ARRIVALS AS FUNCTION OF RANGE AND FREQUENCY.

ECHO, REVERBERATION, AND SCATTERING STUDIES

Short Range Scattering Studies at 12 kc (Dr. Hersey).

A towed fish designed and constructed by the Commercial Engineering Company was received in May. This fish contains an EDO UQN-1c transducer mounted to train its main lobe horizontally in response to a standard 7G, Mark 3, Mod. 3 selysn motor drive (Figure 2). It is mounted on 85 feet of chain similar to the thermistor chain. This chain is handled currently from the 85-foot-capacity winch mounted on the port side (aft) of CHAIN. The fish was given a series of towing, noise, and general performance tests during CHAIN Cruise #19 to the Puerto Rico Trench. The fish towed in a stable manner at all speeds of CHAIN (up to 14 knots). Noise tests over a band from 50 to 20,000 cps were recorded on tape. These were recorded as functions of azimuth and ship's speed. Without detailed analysis, we can only recognize the large effect of ship's noise in the azimuth dependence, and of course the corresponding level increase with ship's speed. We anticipate that this system will be a definite improvement over our previous lead ball echo ranging fish.

Cooperative Project with ComDesDevGroup II (Dr. Hersey).

This project was inactive during this quarter, except for our continuing to loan ComDesDevGroup II one Precision Graphic Recorder for studies carried on independently there.

SUBMARINE GEOLOGY AND GEOPHYSICS

Narragansett Bay Seismic Reflection Survey (Dr. Hersey, Mr. Nalwalk, and Mrs. Nalwalk).

During this period the text of the report to the U. S. Army Corps of Engineers was completed. Manuscript copies of it and other data required by our contract with the Corps of Engineers were presented to them, thus fulfilling the contract under which ship time for the first part of this study was provided. This report will be submitted to the Bureau of Ships as a technical report under Contract NObsr-72521 since the work was supported mainly under this contract.

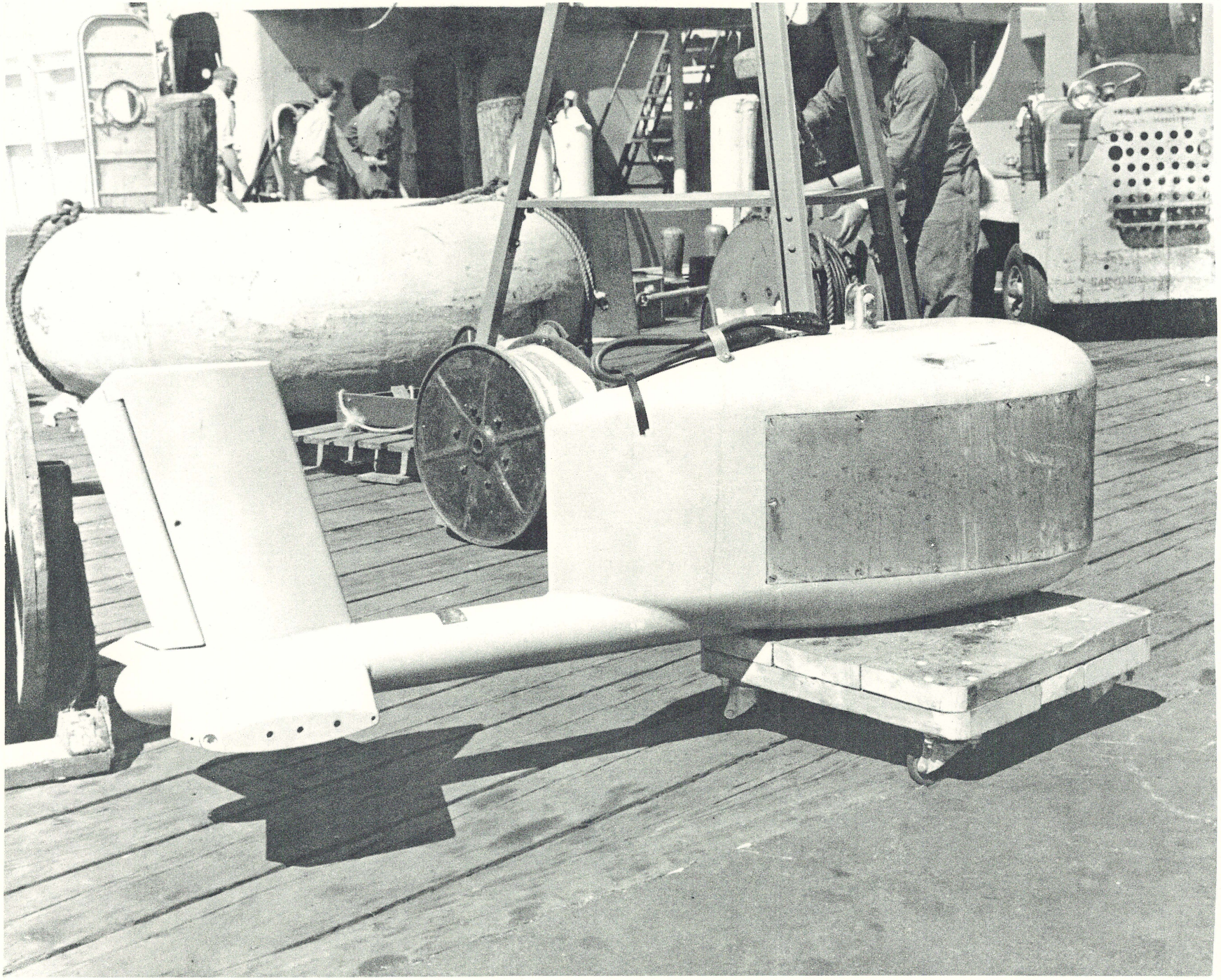


FIGURE 2. THE NEW TOWED SCAN FISH

In May of this year additional seismic reflection records, using the Edgerton "Thumper", were taken in the portion of Rhode Island Sound directly south of Narragansett Bay. These records are generally quite clear showing shallow and intermediate reflections and a deeper reflection from an apparent bedrock surface. They have not yet been fully analyzed, but it is expected that the results will be combined with the data presented in the report discussed above for publication.

Seismic Refraction Studies in the Mediterranean Sea (Mr. Fahlquist).

The interpretation of travel time plots for profiles 196 and 197 (1958) located between Spain and the Balaeric Islands have been completed. This completes the analysis of data obtained in 1958 by the R/V ATLANTIS and R/V VEMA. Analysis of travel time plots for profiles 3 and 4 (CHAIN 1959) are continuing. The completed travel time plots and results are being put in a form for publication.

APPENDIX

Use of Vessels

Operation of R/V BEAR during this quarter was as follows:

Cruise No.	Departure Return	Work Area	Principal Investigation	Scientist in Charge
261	22 May 1961	Woods Hole - Newport	Thumper Studies	A. J. Nalwalk
	26 May 1961	Long Island Sound		
262	6 June 1961	Outer Cape	Sparker Studies	H. Hoskins
	10 June 1961	Hydrographer's Canyon		

Operation of R/V ATLANTIS during this quarter was as follows:

266	19 June 1961	Blake Plateau	Continuous Seismic Profiling, Bottom Photography, Dredging	T.R. Stetson

Visitors's List

Mr. G. B. Tirey	Alpine Geophysical Association
Mr. F. A. Blacquier	Ampex Data Products Company
Mr. D. E. Thomas	Ampex Instrument Company
Mr. D. Cline	Autonetics
Mr. B. J. Carroll	Benson Lehner Corp.
Mr. F. Lyon	" " "
Mr. E. Brainard	Braincon Corporation
Mr. J. Daintith	British Admiralty
Dr. J. Tunstead	" "
Mr. T. R. McGetchin	Brown University
Mr. J. H. Watson	Douglas Aircraft Company
Prof. H. E. Edgerton	Edgerton, Germeshausen & Grier
Mr. G. F. Gruber	Electronic Associates Inc.
Mr. G. Kleiber	" "
Mr. G. J. Meyr, Jr.	" "
Mr. R. Foulke	Eltron Engineering Sales, Inc.
Mr. D. F. Olson	Engineering Model Laboratory, Inc.
Mr. J. T. Ruisett	" " "
Mr. M. Murphy	General Electric Co. - Syracuse, N. Y.
Mr. H. E. Wyeth	" " "
Mr. R. B. Costello	General Motors, Inc.
Mr. R. L. Erath	Grumman Aircraft Co.

Mr. F. S. Bupp	Hughes Aircraft Company
Mr. D. A. Murphy	" " "
Dr. Theodor Stocks	Institution für Meereskunde
Dr. Mario Teruggi	La Plata Museum - Argentina
Dr. R. A. Frosch	Hudson Laboratories
Mr. W. B. Berik	Narragansett Marine Laboratory
Mr. W. J. Slater	Naval Research Establishment
Mr. M. Flato	Naval Research Laboratory
Mr. H. T. Forsberg	Neutron Corporation
Mr. A. Forrester	Office of Naval Research - Boston
Mr. J. McGrath	" " "
Mr. A. Drake	Radio Corporation of America - Camden
Mr. A. Lane	" " "
Mr. C. F. Morey	Raytheon Mfg. Corp.
Mr. S. Wisotsky	" " "
Mr. D. L. Harris	TENS
Mr. W. T. Hammond	U. S. N. Hydrographic Office
Mr. W. B. Randlett	" " "
Mr. D. F. Varson	" " "
Mr. Gunter Dietrich	Univ. of Kiel - West Germany
Dr. Joff Nichols	University of Manchester
Mr. L. Langan	Varian Associates
Mr. L. C. Baines	W. M. Hague Company
Mr. L. Hague	" " "
Mr. H. E. Ellerman	Westinghouse Electric Company
Mr. A. D. Foster	" " "
Mr. P. S. Hughes	" " "

Personnel

Hersey, J. B.	Geophysicist
Foster, D. B.	Administrative Assistant
Vine, A. C.	Physical Oceanographer
Hays, E. E.	Physicist
Voorhis, A. D.	"
Dow, W.	Electronics Engineer
Schevill, W.	Associate in Oceanography
Roberts, Helen	Associate in Mathematics
Backus, R. H.	Marine Biologist
Baxter, L.	Res. Assoc. in Physics
Bunce, Elizabeth T.	" " "
Graham, J. W.	Res. Assoc. in Geology
Pratt, R. H.	" " "
Knott, S. T.	Res. Assoc. in Engineering
Bradshaw, A. L.	Res. Assoc. in Mathematics
Caulfield, D. D.	Res. Assistant in Physics
Graham, Helen-S.	" " "
Cain, H. A.	Res. Assistant in Engineering
Carter, A. L.	" " "
Dimock, A. D.	" " "
Hess, F. R.	" " "
Hoadley, L. D.	" " "
Johnston, A. T.	" " "
Stillman, S. L.	" " "
Sullivan, J.	" " "

Personnel (cont.)

Sutcliffe, T. O.	Research Assistant in Engineering
Watkins, W. A.	" " "
Wilharm, L.	" " "
Wing, A. S.	" " "
Witzell, W.	" " "
Birch, F.	Research Assistant in Geophysics
Breslau, L.	" " "
Fahlquist, D. A.	" " "
Arends, J. G.	Research Assistant in Geology
Nalwalk, A. J.	" " "
Stetson, T. R.	" " "
Hellwig, Jessica	Research Assistant in Mathematics
Kittridge, Sally	" " "
Bergstrom, S. W.	Research Assistant in Underwater Acoustics
Dunkle, W. M.	" " " "
Morehouse, C. B.	Electrical Technician
Riegel, R.	Technical Assistant
Broughton, Jane	Technician
Gallagher, Gloria	"
Grant, C.	"
Hays, Helen	"
Nalwalk, Anne H.	"
Jones, Barbara	Editorial Assistant
Broadbent, Alice	Secretary
Hannah, Mary Ann	"
Mellor, Florence	"
Ostiguy, Betty	"
Gifford, Charles	Northeastern Univ. - Cooperative Student
Wilde, Donald	" " " "
Barnes, Peter	Antioch College - Cooperative Student
Chi, Vernon	" " " "

Summer Personnel

College Faculty

Anderson, Roy T., Chairman Dept. of Physics - Clark University
Nowak, Richard, Assist. Prof. Engr. Physics - Univ. of Toledo

WHOI Summer Fellowships

Hecht, Kurt
Rhodes, Robert

Graduate Students

Bennett, Lee C.
Cone, Richard
Hoskins, Hartley
McGetchin, Thomas

College Graduates

Gray, Donald
Gunn, Alan
Lambert, Richard
Lawrence, Frederick
Massouh, Michael
Rothe, Barbara

College Students

Beamish, Peter
Jacobs, Stanley
Kappel, Gertrude
Keith, David
Ketchum, Carl
Krotser, Donald
Lister, Clive - Cambridge Univ. - England
McConnell, Carl
Odum, William
Schwarz, John
Wiler, Curtiss

High School Graduates

Garrett, Jacqueline
Gerrace, Ricki
Wakelin, James

DISTRIBUTION LIST
WHOI REFERENCE NO. 61-25

	No. of Copies
Bell Telephone Laboratories Whippany, New Jersey Attn: C. F. Weibush, Dept. 411	2
Chief, Bureau of Ships Department of the Navy Washington 25, D. C.	
Attn: Code 689B	2
Code 335	5
Code 631	1
Code 342C	1
Bureau of Naval Weapons Department of the Navy Washington 25, D. C.	1
Hudson Laboratories Dobbs Ferry, New York Attn: Dr. R. A. Frosch	1
Hydrographer U. S. Navy Hydrographic Office Washington 25, D. C.	2
Director Lamont Geological Observatory Torrey Cliff Palisades, New York	1

	No. of Copies
University of California Marine Physical Laboratory of the Scripps Institution of Oceanography San Diego 52, California Attn: Dr. F. N. Spiess, Director	1
Office of Naval Research Department of the Navy Washington 25, D. C. Attn: Code 416	1
Code 418	1
Code 466	1
Mr. John W. Wescott Fluid and Solid Mechanics Laboratory Institute of Science and Technology Post Office Box 618 Ann Arbor, Michigan	1
Ordnance Research Laboratory Pennsylvania State University University Park, Pennsylvania Via: Production Representative	1
Commander Submarine Development Group TWO c/o Fleet Post Office New York, New York	1
Head, Department of Oceanography Texas A and M College Station, Texas	1
Director, University of Miami Marine Laboratory 1 Rickenbacker Causeway Virginia Key Miami 49, Florida	1

	No. of Copies
Director, Narragansett Marine Laboratory University of Rhode Island Kingston, Rhode Island	1
Defense Research Laboratory University of Texas Austin, Texas Attn: Dr. C. P. Boner, Director	1
Commander U. S. Naval Ordnance Test Station Pasadena Annex 3202 East Foothill Blvd. Pasadena 8, California Attn: Library	1
Librarian U. S. Naval Postgraduate School Monterey, California	1
Commanding Officer and Director U. S. Navy Electronics Laboratory San Diego 52, California	1
U. S. Navy Research Laboratory Washington, D. C.	
Attn: Code 5500	1
Code 5510	1
Code 2021	1
U. S. Navy Research Laboratory Washington, D. C. Attn: Dr. R. M. Page	1
Office of Naval Research Project Officer U. S. Navy Sofar Station APO 856 c/o Postmaster, New York	1

	No. of Copies
Director U. S. Navy Underwater Sound Laboratory Fort Trumbull New London, Connecticut	3
U. S. Navy Underwater Sound Laboratory Fort Trumbull New London, Connecticut Attn: Dr. Horton	1
Force ASW Officer Commander, Submarine Force U. S. Pacific Fleet c/o Fleet Post Office San Francisco, California	1
Commanding Officer and Director David Taylor Model Basin Washington 25, D. C. Attn: Code 560	1
David Taylor Model Basin Washington 25, D. C. Attn: Dr. K. E. Schoenherr	1
Office of Naval Research 495 Summer Street Boston, Massachusetts	1
Commanding Officer U. S. Navy Mine Defense Laboratory Panama City, Florida	1
Commander Air Force Missile Test Center Technical Library, MU-135 Patrick Air Force Base, Florida	1

	No. of Copies
Daystrom Electric Division of Daystrom, Inc. 753 Main Street Poughkeepsie, New York	1
Commanding Officer U. S. Naval Ordnance Laboratory White Oak, Maryland Attn: A. T. Jaques (RA)	1
U. S. Naval Ordnance Laboratory White Oak, Maryland Attn: Captain M. A. Peterson, USN	1
U. S. Naval Ordnance Laboratory White Oak, Maryland Dr. G. K. Hartmann	1
Anti-Submarine Defense Force U. S. Atlantic Fleet U. S. Naval Base Norfolk 11, Virginia	1
National Academy of Sciences 2101 Constitution Avenue Washington, D. C. Attn: Mr. James Probus	1
U. S. Naval Air Development Center Johnsville, Pennsylvania Attn: Dr. Harry Krutter	1
Commander U. S. Naval Ordnance Test Station China Lake, California Attn: Technical Director	1

	No. of Copies
Commander (Code 753) U. S. Naval Ordnance Test Station China Lake, California Attn: Technical Library	1
U. S. Naval Underwater Ordnance Station Newport, Rhode Island Attn: Dr. G. G. Gould	1
Applied Physics Laboratory University of Washington 1013 East 40th Street Seattle 5, Washington Attn: Dr. J. B. Henderson	1
Ordnance Research Laboratory University Park, Pennsylvania Attn: Dr. V. Albers	1
Commanding Officer and Director U. S. Atlantic Fleet ASW Tactical School Norfolk, Virginia	1
ONR Liaison Officer Woods Hole Oceanographic Institution Woods Hole, Massachusetts	2
Commanding Officer U. S. Naval Underwater Ordnance Station Newport, Rhode Island	1
U. S. Naval Air Development Center Johnsville, Pennsylvania Attn: Captain E. E. Fawkes, USN	1
David Taylor Model Basin Washington 25, D. C. Attn: Capt. Obermeyer, USN	1

	No. of Copies
U. S. Navy Underwater Sound Laboratory Fort Trumbull New London, Connecticut Attn: Captain Andrews, USN	1
U. S. Navy Research Laboratory Washington, D. C. Attn: Captain Krapf, USN	1
Director Scripps Institution of Oceanography La Jolla, California	1
Research Analysis Group Brown University Providence, Rhode Island	1
Dr. G. P. Woollard Department of Geology University of Wisconsin Madison 6, Wisconsin	1
Dr. Edward Thiel Department of Mines & Metallurgy University of Minnesota Minneapolis, Minnesota	1